RESEARCH HIGHLIGHT

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ANALYSIS OF VENTILATION SYSTEM PERFORMANCE IN NEW ONTARIO HOUSES

INTRODUCTION

Mechanical ventilation systems have been mandated in the National Building Code of Canada (NBCC) in the 1990 and 1995 editions. New Canadian houses are known to be too tight for incidental air leakage to provide sufficient ventilation air for occupants. The mechanical ventilation systems described by the NBCC are meant to represent the minimum systems that will ensure adequate ventilation.

Code officials in each province generally adopt most of the National Building Code for the provincial editions, however—several provinces have modified the ventilation sections provided by the NBCC, specifically *Section 9.32 Ventilation*. Local trades, associations, home builder groups, code officials, etc. can make the argument to the provincial code authorities that they have a preferable way of dealing with issues, such as ventilation, and those recommendations are often integrated into provincial code. In the case of Ontario, the 1993 and 1997 building codes have distinct differences in the ventilation sections from the NBCC and from other provincial codes. One of the major changes is that exhaust-only ventilation (EOV) is explicitly recognized. Exhaust-only systems sometimes cause problems with combustion venting in new homes, as the level of house depressurization caused by the exhaust system may affect chimney-vented appliances. The Ontario code addressed this risk by mandating spillage-resistant appliances and prohibiting wood combustion in houses with exhaust-only ventilation systems. These were labelled Type 1 houses.

A basic Ontario system consists of a ventilation fan switch (labelled *Ventilation Fan*) that is located in the main living area of the house, adjacent to the thermostat. Operation of the switch generally activates a bathroom exhaust fan. The intent is to distribute the infiltrating fresh air (that balances the exhaust flow) by simultaneously activating the forced air furnace circulating fan, which will mix house air and distribute it quite evenly around the house. Systems such as this have been shown to work effectively. An exhaust fan working without circulating air does not provide suitable ventilation for all parts of the house. While it was suggested by some that the ventilation fan switch should also turn on the furnace circulation fan, code writers thought that this would be too complicated or expensive. Instead, the homeowner would be educated on how to run the system and could adapt to the two-step activation.

The new Ontario ventilation systems were tested in a research project published in 1994 (BLP 1994). There were six houses with EOV in that sample of 24. Most of the houses did not have the required fan switch on the thermostat; the ventilation switch was unlabelled in most houses; the homeowners with EOV did not see their systems as ventilation systems and used them infrequently. Despite these early results, the EOV system has become the most popular system installed in new Ontario houses. With the advent of changes to NBCC and to the CSA ventilation standard, CSA F326, several people recommended that codes and standards adopt the Ontario approach. The early research and anecdotal data suggested that, while the system might be popular with

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builders, it was not being used. Canada Mortgage and Housing Corporation (CMHC) decided to conduct a short survey to verify the use and utility of exhaust-only systems.

RESEARCH PROGRAM

The research was conducted during the fall of 2003. University students in architecture or engineering surveyed new house owners in three parts of Ontario: Ottawa, Toronto and Guelph. The houses had to be built in 1995 or later. The surveyor asked the homeowner about the ventilation system installed, how they used the system, their habits of window opening, and whether they had air quality problems. In some houses, they took some rudimentary measurements of air flow with the CMHC garbage bag technique (**http://www.cmhc-schl.gc.ca/en/burema/gesein/abhose/abhose_ce46.cfm**) The ventilation systems found included exhaust-only ventilation (EOV), heat recovery ventilators (HRV), and others. For the EOV systems, the surveyors were looking for the critical coincident activation of the ventilation fan and the furnace circulating fan.

RESEARCH RESULTS

The research showed that the most common ventilation system in the Ontario survey was the exhaust-only system, with 76 per cent of the houses having EOV systems. Another 16 per cent of the houses had HRV's. The homeowners surveyed were generally unaware that the furnace circulation fan had to be operated simultaneously.

Data on the operation of the HRVs and other ventilation systems found are less conclusive. There were fewer examples, and complexity of the installations led to interpretation difficulties for the surveyors.

The data collected on system performance and user satisfaction was largely qualitative. Over 30 per cent of owners of EOV systems never used the systems. Most of the other EOV owners indicated that they used the bathroom fans for room odour and humidity, but did not use them for general ventilation. Almost 50 per cent of the EOV owners stated their systems were "too noisy." A significant number of homeowners identified problems such as window condensation or stuffiness that could be remedied by operating a ventilation system.

Operation of exhaust-only ventilation systems (n = 91)

Method of operation	Frequency	Percentage
No idea	9	9.9
Only exhaust fan operated	63	69.2
Only circulation fan operated	7	7.7
Exhaust and circulation fans operated together	12	13.2

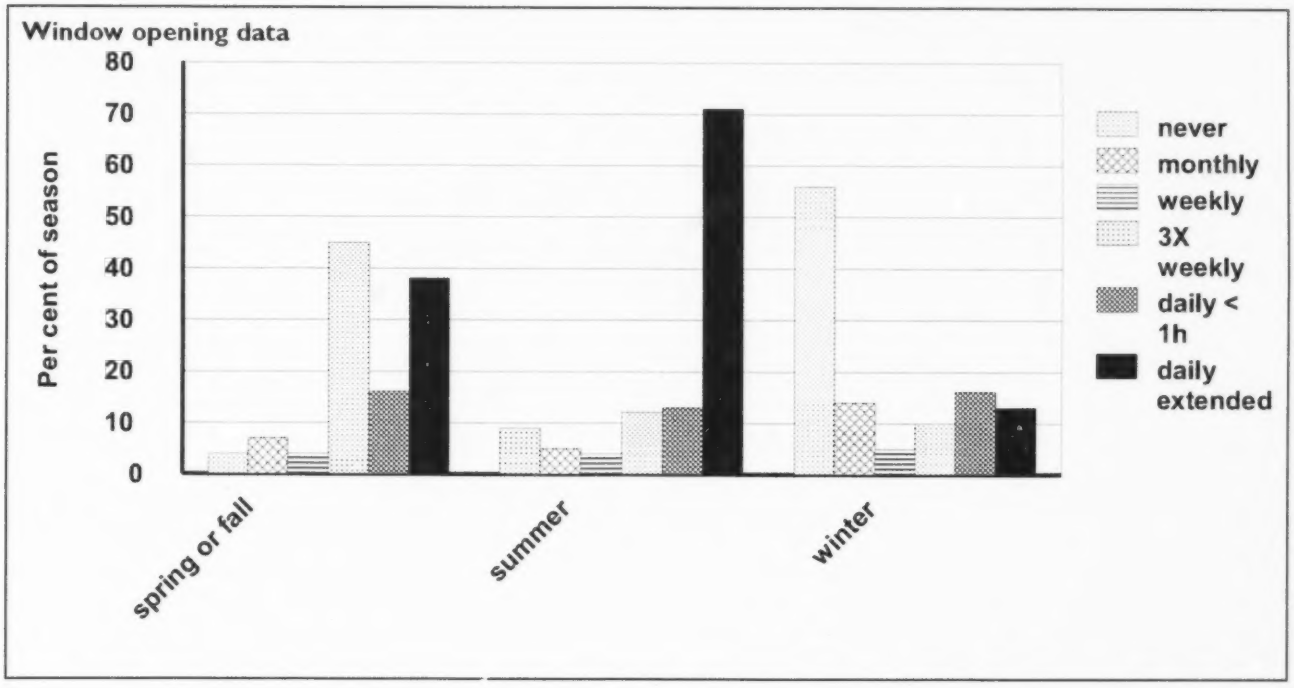
The window opening data collected was almost incidental to the study but may be of interest to researchers or window manufacturers.

Over 90 per cent of new homeowners in Ontario do open windows, with over 40 per cent opening windows for periods of the winter. In mid-summer, almost 10 per cent do not open windows at all, which may indicate continuous use of air conditioning systems. These houses would benefit from mid-summer ventilation to provide fresh air to the houses.

IMPLICATIONS FOR THE HOUSING INDUSTRY

The data collected shows that the most common Ontario ventilation system in the last 10 years, exhaust-only ventilation, is not being used properly. Having separate switches for the designated ventilation fan and the furnace circulation fan means that the two are rarely operated simultaneously. Homeowners do not recognize the bathroom fan approach as a "ventilation system" and do not activate it, yet there are problems with house humidity levels and indoor air quality that would benefit from a properly operated ventilation system.

Future codes should at least upgrade such systems to interlock the ventilation fan and the furnace circulating fan.



Reference: Buchan, Lawton, Parent Ltd.
1993 Ontario Building Code Mechanical Ventilation Assessment, for Ontario Hydro, Ontario Ministry of Housing, Ontario New Home Warranty Program, Ontario Natural Gas Association, 1994.

CMHC Project Manager: Don Fugler

Field surveyors: Caroline Prochazka, Ranya Sherif, P. Christopher Timusk

Housing Research at CMHC

Under Part IX of the *National Housing Act*, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

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or contact:

Canada Mortgage and Housing Corporation
700 Montreal Road
Ottawa, Ontario
K1A 0P7

Phone: 1 800 668-2642
Fax: 1 800 245-9274

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